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The Process of Pension Forecasting

Michael Sze
Hewitt Associates

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Abstract

This paper explains the process of pension forecasting. It discusses the common purposes and uses of pension forecasts, the major steps involved, and the principal limitations of these forecasts.

Some insights into each stage of the forecasting process are provided. Among the stages discussed are: the background research to be performed; the selection of scenario assumptions; shortcuts used in the actual performance of the forecast; review of the forecast results; and communication of the forecast findings.

Key words and phrases: *projection, simulation, stochastic modeling, scenario*

1 Introduction

Funding retirement obligations has become a significant part of corporate financing. It is not unusual for a plan providing rich retirement benefits with indexation or one with substantial unfunded past service liability to require an annual contribution in excess of 15 percent of payroll. The unfunded liabilities of some companies' pension programs are equal to a sizable portion of their net worth. Union negotiation settlements hinge more and more on pension agreements. As a result, many companies include a pension forecast[1] in their regular financial planning process.

The responsibility for providing such a pension forecast typically is delegated to the actuary. Most actuaries are familiar with the

* Michael Sze is a Fellow of both the Society of Actuaries and the Canadian Institute of Actuaries. He received his Ph.D. degree in mathematics from the Ohio State University and currently is a partner of Hewitt Associates. He is the chair of the Society of Actuaries Retirement Systems Research Committee, as well as a member of the Canadian Institute of Actuaries Investment Practice Committee. While the author takes full responsibility for any errors in this article, he would like to acknowledge, with gratitude, the valuable comments provided by Ms. Rita Lawlor, Ms. Milena Francia, Ms. Megan Duke, and Mrs. Elsie Sze in the preparation of this article, as well as many helpful suggestions by the referees.

[1] The terms *projection* and *forecast* are used interchangeably in this paper and in the pension actuarial literature in general.

basic mathematics involved in a pension forecast because of their training and education. Many inexperienced actuaries, however, are not familiar with the actual process of a pension forecast. In fact, some pension valuation actuaries actually have difficulties making forecasts, primarily due to the fact that they do not fully recognize the difference in emphasis between an actuarial valuation and a forecast. The former focuses on the present; its aim is to provide an accurate assessment of the funded status and cost of a pension plan under the current legal and accounting environments. The latter is directed toward the future trend of pension costs under varying economic or demographic scenarios.

The consequence of not understanding the forecasting process fully can be costly. At best, the actuary may have difficulty explaining the cause and effect of some economic variables. At worst, faulty assumptions or logic can lead to erroneous conclusions with detrimental effects to the company. Because there are many variables involved in the process, there is a real danger that errors often are not detected until the damage has been done.

The purpose of this paper is to share some of my experiences in pension forecasting, to provide some insights regarding the process, and to point out some possible pitfalls. Because of the complex nature of a pension forecast, it is impossible to cover every possible situation. This article, however, can be used to assist in more diligent planning of each forecast; it is not a cookbook to be followed in every step of the process. Readers are assumed to be familiar with the basic techniques and mathematics of the projection process.[2]

This article is organized into six sections, each of which is briefly described below.

- **Preparation for a Forecast**: This section discusses the major considerations and background research that must be performed before embarking on the forecast. Most problems confronted in pension projection originate from insufficient preparation;
- **Choice of Scenario Assumptions**: This section covers some basic considerations underlying the choice of scenario assumptions. These assumptions represent management's best guess of future economic events. Such assumptions control the projected results and must reflect the principal objective of the projection;
- **Performing the Forecast**: This section discusses the choice of the projection method. The purpose and needs of the sponsor determine the scope of the forecast;

[2] Readers interested in the details of the pension forecasting process may refer to Lorisz (1993), Sze (1997), or Schnitzer (1977).

- **Review of Forecast Results**: This section proposes a criterion for making such a judgment and provides some hints on the review process. It sometimes requires a lot of experience and intuition to judge whether forecast results are reasonable;
- **Communication of Forecast Findings**: Forecasting is as much an educational process as a technical process. Forecast findings are of no use unless they are understood. This section provides some insights on the communication of the projection results; and
- **Other Considerations**: This section compares the forecasting and actuarial valuation processes and outlines some limitations of forecasting.

2 Preparation for a Forecast

The importance of preparation cannot be overemphasized. Even the most experienced actuary must have on hand a detailed preparation of what he or she plans to accomplish with the forecast. A detailed preparation should consider: (1) the purpose of the forecast; (2) the sponsor, the industry, and the economic environment; (3) the demographics of the population; (4) the pension plan, the valuation methods, and the actuarial assumptions; and (5) past plan experience and the funded status of the plan.

2.1 Purpose of the Forecast

Unlike funding and expensing valuations which are required by governmental regulations, there are no legal or accounting rules requiring pension projections. The request to perform a pension projection study usually originates from plan sponsors who need answers to specific questions concerning their pension plans. Before the actuary begins the study, it is important that he or she knows what those questions are and the reasons for the questions. Knowing the purpose of the forecast will lead to a better understanding of the sponsor's funding and expensing expectations and the sponsor's risk tolerance. An integral part of the forecast is the testing of the achievability of the sponsor's objectives under legal, accounting, and economic constraints. Understanding the sponsor's expectations and risk tolerance also will provide guidance on the choice of scenario assumptions, the scope of the study, and the best way to communicate the forecast's findings.

The emphasis of a forecast depends a great deal on its purpose. A forecast that is part of the regular corporate financial planning process may have as its goal one of the following: (1) to determine the stability of pension contributions and expenses; (2) to devise funding

and investment strategies that will minimize unexpected fluctuations in contributions and expenses; or (3) to devise an asset/liability matching strategy to minimize undesirable deterioration in the funded status of the plan.

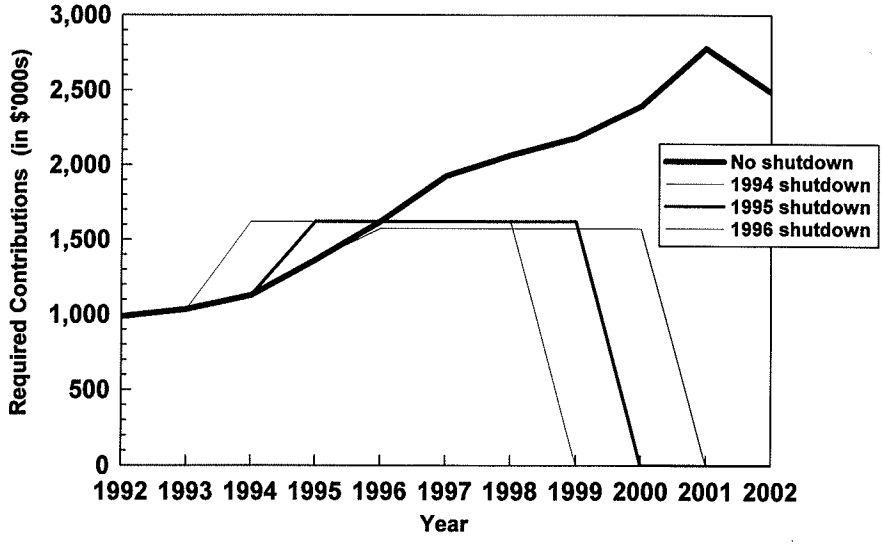
A few examples may illustrate some of the considerations involved:

- **Downsizing**: In a downsizing operation, the forecast should anticipate significant aging of the group, the possibility of an employer-initiated early retirement program, and a decrease in population size. The chance of plan terminations typically cannot be ruled out. There is a need to monitor the risk of having to fund the entire plan deficiency over a short period of time. The alternatives that should be considered are amortization and bond immunization.[3] In one such study, a sponsor had to consider the impact of the timing of plan termination after a downsizing process. Figure 1 shows the funding impact of plan termination in different years, assuming that plan termination deficiency is amortized over five years. It further demonstrates that the funding pattern is practically the same (except the incidence of payments), irrespective of the timing of the plan termination decision. The actuary in this case was instructed to monitor interest rates for the sponsor. An annuity contract was placed at an opportune time which allowed the sponsor to save millions of dollars on the plan termination cost;
- **Changing Employment Pattern**: As a result of the demographic pattern of aging shown in the United States and Canada, many retail companies have experienced a significant shift in hiring patterns. Companies often want to know the impact of such demographic changes on future pension costs. In such a study, the emphasis must be to balance the need for adequate retirement benefits for the employees with the need for stable pension contributions and expense for the employer. The alternatives that should be considered are plan design changes (such as a change from a defined benefit plan to a defined contribution plan) and funding basis changes (such as changes in retirement age and turnover assumptions). The scenario assumptions used must reflect age and sex distributions of new employees as well as more realistic pay and termination patterns for these employees.

  In the early 1980s, a major department store expected that new hires would be substantially older and would include a larger percentage of females. Many of the new hires would be the secondary wage earner of the family and might not be as career-aggressive as were previous employees. A forecast study was commissioned to study the pension cost impact of these demographic changes as well as to suggest alternative plan designs. The plan had a sizable funding surplus, so the contribu-

[3] Readers interested in the theory and application of bond immunization should see Redington (1952), Tilley (1980), and Bader (1983).

Figure 1
XYZ Corporation Retirement Plan Impact of Shutdown



ion pattern was not a major concern. The cost considerations were directed to the trend of pension expense as a percentage of payroll. The study analyzed the net cost increase after taking into account the offsetting impact of aging, a more moderate rate of salary increases, and a higher turnover rate. The expense increase was moderate and was considered to be manageable by the plan sponsor. The defined contribution alternative, while helpful in stabilizing pension cost, was considered to be too drastic and was deemed to provide unsatisfactory retirement income for employees. In the end, no major plan design changes were made. There were, however, some changes in actuarial valuation assumptions to reflect more realistic expectations of salary progression and turnover pattern;

- **Financial Planning to Stabilize Pension Expenses**: Financial Accounting Standard No. 87 requires that the discount rate used to determine pension liabilities and service cost must be based on the current market interest rate. Plan sponsors feel vulnerable to unpredictable shifts in economic situations, especially given the volatility of market interest rates in recent years. Also, the fluctuating investment returns of pension funds add to the uncertainty of the pension cost. A forecasting study may be ordered to determine a stable projected pension expense trend. The alternatives considered typically include asset/liability matching. Numerous other articles have covered asset/liability matching and immunization.[4]

  Many forecasts have been prompted by investment advisors. The actuary is asked to provide the liability and cash flow trends of the pension fund. A forecast is performed to test investment policies against the deterministic liability trend in order to find the investment mix that best protects the surplus of the plan. These forecasts often result in a recommendation for a higher investment concentration in bonds.

  This approach to projection misses the interplay between assets and liabilities. A detailed stochastic projection involving both assets and liabilities (usually referred to as *asset/liability modeling*) will tend to produce substantially different results. For example, an inflationary environment will impact both wage increases and investment returns simultaneously. Only an asset/liability modeling process will be able to capture the correlated events between assets and liabilities; see Beekman (1980), Redington (1952), and Tilley (1980); and

- **Postretirement Medical Benefits Forecast**: Many companies are interested in investigating the immediate and continuing impact of FAS 106 rules. These rules require companies to book liabilities and expenses for postretirement medical and other benefits. Because of the scarcity of background information, many attempts

[4] A discussion of asset/liability matching and immunization is beyond the scope of this article. For more information on this topic, see Beekman (1980), Tilley (1980), and Redington (1952). For more on immunization and how it may help to stabilize pension cost, see Daskais and LeSueur (1983) and Sze (1993).

to forecast the impact of FAS 106 have been performed that treat the postretirement medical benefit payments as a stream of escalating annuity payments during the life of the beneficiaries, with the escalation reflecting medical inflation. The present value of these payments usually is determined by using expected investment returns and the mortality and termination decrements used in pension valuations. Other considerations usually include alternative expensing bases and benefit designs.[5]

There are two potential flaws to forecasts performed in the manner described in the last paragraph. First, the pattern of postretirement medical benefit payments is different from that of an escalating annuity. A major portion of medical expenses are incurred during the last few years of a person's life; see Riley and Lubitz (1989).[6] Second, the present value calculations in many FAS 106 projections are based on mortality and termination rates used in pension valuations. Mortality rates used in a pension valuation often overstate actual experience, while termination rates typically understate actual experience. Such discrepancies may have a significant impact on the liability and service costs calculated.[7]

Aside from the flaws in many FAS 106 studies, the forecast results still may present valuable information to plan sponsors. After the initial shock of the drastic cost impact of providing these benefits, many plan sponsors would explore other plan design alternatives such as requiring employee contributions, establishing maximum benefit limits, or replacing welfare benefits by additional pension benefits.

Advance funding of this obligation may be considered. Funding alternatives often investigated include funding through the pension plan based on Internal Revenue Code (IRC) Section 401(h) or establishing a separate trust under IRC Section 501(c)9. Under some restrictive conditions, IRC Section 401(h) allows funding of such postretirement health benefits in a pension plan. IRC Section 501(c)9 allows prefunding of welfare benefits under limited conditions; see Hess, Becker, and Snyder (1991) and Kra and Resse (1992). Expensing alternatives include immediate recognition of past service liability or amortizing this liability over the expected future service of the employees.

The above examples illustrate the need for the forecast to reflect the purpose of study. It is important to note that because each project is initiated to address a specific problem, the actuary should provide

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[5] For more on funding postretirement medical benefits, see Roccas, Sobel, and Ullman (1990) and Veach, Cotter, and Meyers (1992).

[6] Further research is needed to determine the actual pattern of payments and the impact of the proper cost attribution. Studies in these areas are currently being undertaken by the Society of Actuaries.

[7] See Vaughn (1992) for more on realistic termination experience.

not only an explanation of the cause and effect of the issue in question, but also alternatives for solving the problem. It is this last requirement that makes a forecasting study more challenging to the actuary and valuable to the sponsor than a regular funding or expensing valuation.

2.2 Sponsor, Industry, and Economic Environment

Forecasting studies never are performed in a vacuum. They are performed in the context of other economic events. A trend of escalating pension costs may be tolerable for a utility company. The rates that a utility company charges its consumers typically are fixed on a cost-plus-margin basis. Thus, any increase in operating cost is passed to the consumers. On the other hand, the same cost trend may be detrimental to a manufacturing company undergoing severe downsizing in a recessionary economic environment. In such an economic climate, the revenue is limited by price competition. Severe downsizing, however, typically entails sizable escalation in pension cost.

Before beginning a projection study of a pension plan, it is important to understand the financial strength of the plan sponsor, as well as the significance of the pension cost in the operating budget of the company. A company with ample resources may be able to tolerate more fluctuation in the pension cost, so the funding time horizon may be longer. Thus, the goal may be to achieve the most favorable long-term financial results, even if it means taking more risks in the interim. On the other hand, for a company with limited resources or whose pension cost is a significant portion of its total budget, care must be taken to ensure acceptability at each forecast year. An unexpectedly high cost at any point may be unacceptable to the company, requiring immediate management attention, which often results in funding and/or investment changes. The constraints for such a forecast are much tighter, and results for each forecast year must be examined carefully.

It is important to understand the business of the plan sponsor. This often dictates the hiring, promotion, and termination patterns of the company. Knowledge of the industry in which the plan sponsor operates provides insights into the growth or retrenchment pattern of the overall employee population, as well as the volatility of such a pattern. Such knowledge determines the choice of demographic scenario assumptions.

Many forecasts are commissioned when the sponsor has a problem that needs addressing. Often these forecasts are performed in times of economic downturn. The future economic outlook is critical is assessing

a plan sponsor's tolerance for cost fluctuations. For a plan sponsor with a severe cash flow constraint, it is of paramount importance that the forecast addresses both the current economic outlook and the consequence of further economic downturn.

2.3 Demographics of the Population

The demographics of the employee population determine not only the current year's cost of the pension plan, they also dictate the future retirement and termination patterns of the plan. Where the cash flow forecast is critical, a careful study of the demographics of the current employee population is vital. Furthermore, a less mature employee population does not have as much pending pension obligation as a more mature population and may have greater tolerance for economic fluctuations. A careful study of the population demographics provides much insight into the trend of the future costs of the plan.

2.4 Pension Plan Valuation Methods and Actuarial Assumptions

The impact of economic factors on the future pension cost depends on the plan's valuation methods and actuarial assumptions. Thus, it is important to review these valuation bases before embarking on the forecasting process. For example, the company's contribution, expressed as a percentage of salary for a defined contribution plan, is insensitive to salary changes. The pension cost of a final average salary defined benefit plan, however, is affected greatly by salary experience, especially if the pension plan benefit is integrated with Social Security. The pension cost of a career average salary defined benefit plan is less volatile with respect to salary experience.

Pension costs under aggregate cost methods are typically less sensitive to the effect of aging populations than are pension costs under individual cost methods.[8] The entry age cost method (among individual cost methods) tends to provide a more stable cost pattern with respect to an aging population than does the unit credit cost method. Unit credit normal cost represents the present value of benefits earned during the valuation year. As the population ages, the normal cost escalates. Entry age normal cost represents the average of such nor-

[8] For a detailed analysis of pension costs methods, see the texts by Anderson (1990) and Berin (1989).

mal costs over the career of the participant. It is more stable relative to the aging process of the population.

A more aggressive actuarial valuation interest assumption anticipates higher investment returns and thus provides less opportunity for asset gains. A higher valuation salary scale assumption anticipates higher cost increases due to pay increases and, therefore, provides greater opportunity for pay gains.

2.5 Past Experience and Funded Status of the Pension Plan

Some economic variables are difficult to predict because their behavior is independent of the past. Many pension plan variables (such as turnover and promotion patterns), however, are not independent of past experience and can be projected with a certain degree of accuracy. A study of past experience of these variables thus provides valuable information for the future. Overall, ignoring past experience in a forecast study is likely to lead to worthless results.

Temporary investment and other experience setbacks may be tolerable for plans that have huge funding surpluses. The experience impact on a plan's funding requirement can be drastic for plans that are only marginally overfunded; therefore, pension forecasts must recognize the funded status in the selection of scenario assumptions.

3 Choice of Scenario Assumptions

Because scenario assumptions control the occurrence of certain key economic events that may impact future pension cost, the proper choice of assumptions is vital to the usefulness of the forecast. These assumptions must echo the purpose of the study, recognize both the plan's and the sponsor's characteristics, and reflect past experience of the plan.

The choice of scenario assumptions must be a *joint* effort between the actuary and the plan sponsor. The plan sponsor's input is critical because scenario assumptions should reflect management's best estimate of future economic events. Furthermore, the sponsor has the best understanding of the needs of the company, the financial risks that it can tolerate, and the company's objectives. The sponsor may not have analyzed past experience as carefully as the actuary, however, and may not have ready access to economic and investment data or have as much understanding of the implications of the choice of some assumptions as does the actuary. Furthermore, the bias of the plan sponsor, whether intentional or not, may prejudice the objectivity of

the analysis. Thus, it is the responsibility of the actuary to provide guidance on the cause and effect of the choices. Where there are doubts about some selected scenario assumptions, alternative assumptions should be tested.

During the process of choosing scenario assumptions, an often asked question is: "What is the valuation assumption?" Such a question usually reflects a lack of understanding of the basic purpose of these two types of assumptions. It is the actuary's responsibility to explain the difference between *forecast scenario assumptions* and *actuarial valuation assumptions*.[9] Actuarial valuation assumptions typically contain a margin of conservation that should be removed in the choice of scenario assumptions for forecasting. For instance, the commonly used valuation mortality table (e.g., 1983 Group Annuity Mortality Table) provides mortality rates that are 10 percent lower than the underlying experience obtained by mortality studies of the population over the same period; see Committee on Annuities (1983 and 1987). Similarly, typical withdrawal tables provide turnover rates that are lower than actual experience; see Vaughn (1992). These subtle differences often are not explained clearly to the plan sponsor. As a result, valuation turnover assumptions often are chosen by default to be the scenario assumptions. For pension plans where the death benefit is comparable to the projected retirement benefit, using a valuation mortality assumption for the scenario mortality rate may not distort future pension cost greatly. Where death benefits are payable in a lump sum, the cash flow pattern will be understated if the actual number of deaths exceeds the expected number of deaths. The distortions introduced by conservative turnover assumptions, however, may be even more significant, as the turnover rate is typically much higher than the mortality rate.

The set of scenario assumptions should include the following groups of assumptions: demographic, economic, and simulation assumptions. This article will not provide a detailed explanation of each scenario assumption. (Interested readers should see Sze (1987) for details.) We will provide, however, a few critical comments on some of them.

3.1 Demographic Assumptions

Demographic assumptions are used to project future employee populations. Such assumptions include the mortality, disability, ter-

[9] See Lorisz (1993) and Sze (1987) for more detailed discussions.

mination and retirement patterns and the number and distribution of new entrants with respect to sex, age, and pay.

Usually mortality and disability scenario assumptions are only age specific. The termination assumption, however, should vary by age and duration and should show a higher turnover pattern during the earlier years of the employees' careers. The retirement pattern should be distributed over the eligible retirement ages. Although the number of new entrants may differ from year to year, the distribution by sex, age, and pay usually is assumed to be the same during the projection period; see Jackson, Haley, and Wendt (1989) and Sze (1987).

For a small pension plan, a significant demographic change would produce a major impact on the trend of pension costs. The assumption of such demographic changes usually is specified by the sponsor.

3.2 Economic Assumptions

Economic assumptions are used to project and determine the assets and liabilities of the plan during the forecast period. These assumptions include: an inflation rate; real or nominal investment rate of return; a salary increase; flat dollar benefit rate increases; and government benefit increases.

Actuaries traditionally assume that the real investment returns and the real rate of salary increases are constant throughout the forecast period. Thus, nominal returns on assets and projected pay increases only fluctuate with inflation. In addition, investment returns and salary increases always move in the same direction. Salary losses consequently are compensated by investment gains and vice versa. In the end, the projected pension cost is more stable than may be expected. In reality, nominal investment returns often are correlated negatively with inflation. (See Table 1.) In times of high inflation, real salary increases may be close to zero. Under such circumstances, pay losses resulting from high inflation rates may be coupled with substantial investment losses. It would be imprudent for actuaries to ignore this worst case scenario.

3.3 Simulation Assumptions

Simulation assumptions are needed to perform stochastic asset/liability simulations. They typically include the economic assumptions discussed above; the real rate of return and the standard deviation for each asset class; the real salary and real benefit

increases and their standard deviations; and the correlation between each pair of variables, as well as the correlation of each variable with inflation.

Many of these assumptions, especially the correlation factors, often are chosen arbitrarily, mainly because both the actuary and the plan sponsor may not have a good feel for the significance of these assumptions. Improper choice of assumptions, however, may distort and invalidate forecast results. Actuaries who wish to develop their expertise in asset/liability simulations are advised to test alternative assumptions to build their intuition in this area.

The following is a correlation matrix of inflation and the real returns of some common asset classes in the United States from 1926 to 1988:

TABLE 1
Inflation and Real Returns, 1926 to 1988

	Correlation Matrix			
	CPI	T-Bill	LT Bonds	S&P 500
CPI	1.00	-0.72	-0.55	-0.24
T-Bill	-0.72	1.00	0.57	0.14
LT Bond	-0.55	0.57	1.00	0.22
S&P 500	-0.24	0.14	0.22	1.00

Sources:

Consumer Price Index (CPI-U)
Bureau of Labor Statistics, U.S. Department of Labor

Three Month U.S. Treasury Bill Yield
1926-1941 Homer Sydney. *A History of Interest Rates: 2,000 B.C. to Present*, Table 51, Part II
1942-1976 Bureau of Economic Analysis, U.S. Department of Commerce, and *1977 Business Statistics*
1977-1983 Standard & Poor's Statistical Service: *Current Statistics, Interest Rates*, p. 4
1984 on *Federal Reserve Bulletin*, Table 1.35, Interest Rates, Line 18

Long-Term U.S. Government Bond Return
1926-1941 *Banking and Monetary Statistics, 1914-1941*, Table 128, p. 468, The Board of Governors of the Federal Reserve System, September 1943
1942-1953 *Banking and Monetary Statistics, 1941-1970*, Table 12.12, p. 720. The Board of Governors of the Federal Reserve System, September 1976
1954-1977 20 Year Treasury Constant Maturity Yield Percent, Average of Daily Figures, *Federal Reserve Bulletin*, Table 1.35, Interest Rates
1978-1985 *Selected Interest Rates*, pp. 10-11, Federal Reserve Bank of Dallas
1986 on 30 Year Treasury Constant Maturity Yield Percent, Average of Daily Figures, *Federal Reserve Bulletin*, Table 1.35, Interest Rates

Standard & Poor's Composite Return
Standard & Poor's Statistics Service: *Security Price Index Record*

4 Performing the Forecast

A critical decision in performing a forecast study is the choice of forecasting method.[10] The reader is assumed to be familiar with the mechanics of the following common forecasting methods:

- The simplified forecast (also called the *back of the envelop* approach);
- The seriatim forecast;
- The forecast based on group data; and
- The stochastic asset/liability simulation.

Instead of reviewing the details of each method, we will provide some hints on the choice of the method.

Over the years I found that almost three quarters of all projections may be performed using the simplified approach. The simplified approach is quick and easy to do and provides reasonable results that reflect the intuition of the actuary. Because of repeated iterations involved in this process, however, inherent estimation errors escalate geometrically. For instance, a 5 percent overestimation of liability each year will compound to over a 60 percent error in ten years. These projection results are typically not reliable after the first five to ten years, depending on the experience of the actuary. Furthermore, the method does not capture the impact of demographic changes readily. Nor is it capable of ascertaining the subtle effect of the application of individual benefit limits. Finally, because this approach is based on the intuition of the actuary, the results must be reviewed carefully by an experienced actuary. The real danger lies in the fact that an inexperienced actuary may produce misleading results without realizing the mistake.

Where detailed results are required, a seriatim or group data forecast is recommended. Because a detailed seriatim forecast is costly, some data grouping usually is deemed necessary. Grouping into age/service/pay cells typically is satisfactory. Highly paid employees and employees close to retirement should be identified separately, however. The termination/retirement patterns for these groups of employees must be handled separately because of their potential impact on pension cost and cash flow of the plan.

[10] It is not the intention of this article to provide a detailed explanation of the various projection methods or the background mathematics. Interested readers are encouraged to study Schnitzer (1977); Jackson, Haley, and Wendt (1989); Lorisz (1993); and Sze (1987).

Asset/liability simulation is used mostly in the process of establishing an investment policy. This type of simulation is very good for analyzing the risk factors involved in a funding or expensing policy. Through numerous asset/liability simulations, one can test a policy under different economic situations. Based on the simulated outcome, the sponsor better may understand the down side of the policy decision. A major difficulty in this type of forecast, though, is in establishing the input assumptions. The actuary should try different sets of input assumptions to gain insight into the effects of the different choices. Another difficulty with these forecasts is the volume of output information generated. The actuary should study the outcome generated carefully and distill these results to the bare essentials before attempting to provide meaningful communication.

5 Review of Forecast Results

The review is the most important technical step of the forecasting process. As mentioned above, the voluminous output generated by this process requires that the actuary diligently sort the results to make sure they make sense and that they address the questions asked.

An important criterion to bear in mind in the review process is simplicity.

> Something must have been wrong if there are no simple explanations for the forecast results. Probably some important factors have been overlooked or have been included improperly in the forecast.

A useful tool to check for reasonableness is to perform a projection of pension liabilities and cost using a *simplified* projection performed under the same scenario assumptions.

A careful review of the simplified projection's results typically will reveal details that have been overlooked or some alternative perspective that warrants further considerations. The full projection then must be revised to reflect these requirements. This cycle of forecast, review, and refinement usually is repeated several times until the actuary is satisfied that all results make sense and the different perspectives have been analyzed.

To date, there is no completely objective criterion for judging the validity of the forecast results. The following are some helpful hints on checking the internal consistency of forecast results:

- Under each funding or expensing basis, the ratio between any pair of the following items is usually rather stable: valuation payroll, normal cost, present value of future compensation, and present value of future normal cost. There is a slightly less stable relationship between each pair of the following items: active accrued liability, active accrued benefit value, and active vested benefit value;
- The relationship between the normal cost and the accrued liability usually shows a stable trend, reflecting gradual increases or decreases in the average age and service of the group;
- For a mature population, the ratio of the inactive accrued liability to the active accrued liability is usually quite stable. On the other hand, for an immature population, that ratio tends to increase over the projection period;
- When comparing results under different funding or expensing bases, note the following relationships:
    - The ratios of corresponding items under the different bases should remain stable;
    - Normal cost increases are more sensitive to the aging pattern of the population under the unit credit cost method than under the entry age normal cost method; and
    - For a final average pay plan, the increases in the accrued benefit value reflect the total pay increase while the increase in the accrued liability only reflects the actual pay increase in excess of the salary scale assumption.

6 Communication of Forecast Findings

From the plan sponsor's perspective, communicating the finding may be the most critical step of the entire process. The actuary must be careful not to confuse the sponsor with the endless stream of numbers from a forecast report. It is important for the actuary to understand forecast results through the review process and essential that he or she be able to share this understanding with the client.

The actuary may believe at the end of a project that the conclusions of the study are self evident. But the forecast findings become obvious to the actuary only as a result of weeks of work and self-education. The final challenge is to educate the audience in the course of a one or two hour meeting.

A useful suggestion is to stay focused on the initial questions asked. Even though millions of numbers are produced, only those relevant to the purpose of the projection should be presented. The fewer the details shown, the more the concept will be absorbed by the listener.

Many actuaries experienced in pension forecasting have told stories of how they were trapped years after a forecast into explaining why their forecast results differed from actual valuation results. It is easy to blame the sponsor's ignorance of the estimations involved in the forecast process. Knowing the limited precision of the results, however, we question why such details ever were communicated in the first place. Were the actuaries unaware of the imprecision involved? Were the actuaries trying to attribute too much exactness to the process?

In spite of the high volume of output data, the principal purpose of the forecast is to analyze trends under various scenarios. Both the trends and the comparisons are easiest to visualize through the use of graphs. Forecasters should experiment with different ways to graphically present their results.

7 Other Considerations

Although both pension actuarial valuations and forecasts are based on the same mathematical principles, the uses of their calculations are quite different. The purpose of an actuarial valuation is to establish the funding and expensing requirements for the year. It is performed under regulatory or accounting rules. The basis of an actuarial valuation tends to be conservative. The results provided often are considered to be exact. On the other hand, the purpose of a pension forecast is to test the future cost impact of some expected or proposed changes. The emphasis is on the future trend of the cost. The important result is the cost comparison under different scenarios. This difference in the basic purpose of the two process is reflected in several factors:

- **Assumptions**: Valuation assumptions have margins of conservation. Forecast scenario assumptions tend to be realistic;
- **Results**: Valuation results often are used to derive exact funding and expensing requirements. Forecast results should be shown as estimates;
- **Time Horizon**: Valuation results are only applicable to the current year. Forecast results may cover ten or more years;
- **Alternatives**: Valuations provide pension cost under specific sets of conditions. Pension forecasting usually is performed to compare pension costs under several alternatives. The goal is to choose the alternative that best reflects the objectives of the sponsor;
- **Variation**: Because of the extended outlook and additional alternatives considered in a forecast, there tend to be more variations

in this process. The forecast is certainly more challenging and more interesting (to me, at least) than a valuation;

- **Estimates**: Forecasting has its limitations. It is important for actuaries not only to understand these limitations, but to communicate them clearly to the plan sponsor. Because of the many shortcuts that the actuary takes in the process, forecast results are estimates. Each individual item (e.g., liabilities, benefit payments, assets, etc.) may differ greatly from that produced by a subsequent valuation. Because of the compensating effect of various actuarial items, however, the aggregate results obtained may still be reliable. Furthermore, comparisons of the trends of pension cost under different alternatives may be valid even when each alternative set of results is slightly off;
- **Scenario Assumptions**: The forecast results directly reflect the scenario assumptions. Because there is no certainty in the input scenario assumptions, the outcome of a forecast has a sizable margin of error. Forecast results should be presented as a range of possible outcomes. The results of a stochastic simulation, especially, should be presented in a probabilistic manner. Cost patterns should be presented probabilistically, i.e., they should communicate both the expected cost trend and the confidence level for such a cost trend through the forecast period; and
- **Forecast Report**: Because forecast results may vary by the process used, a forecast report should state clearly the methodology and assumptions, the data approximation, and other estimations employed. It is not necessary, and is often misleading, to provide detailed results for each forecast year. On the other hand, it is useful for the report to include an executive summary section that addresses the questions asked and provides concise conclusions of the study. Graphs should be used where appropriate to summarize cost trends and provide visual comparison of the alternatives.

In conclusion, forecasting is still more of an art than a science. Actuaries should not be uncomfortable about the estimations involved in the process. Even with all its limitations, however, forecasting is still one of the best tools available to help sponsors make financial decisions concerning their pension plans. Corporate executives need to make financial projections regularly, and they may find pension forecast results to be far more reliable than many of the other estimates used in corporate planning. Readers are encouraged to pursue the subject further.

In the end, forecasts are typically very exciting projects. Forecast findings usually receive much greater attention than do regular actuarial valuation results.

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Michael Sze
Hewitt Associates
4110 Yonge Street
North York, ON M2P 2B7
Canada